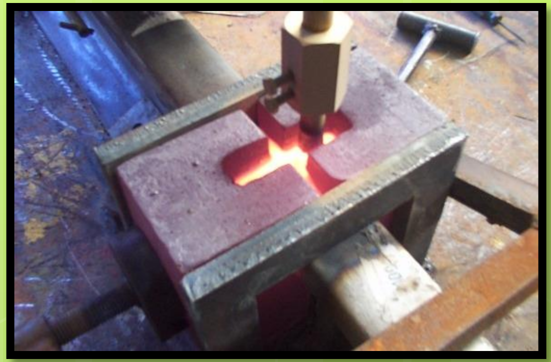

PROCESO VERTIRIEL

PROSOLSA

www.prosolsa.cl
Leon de la Barra #9401 Lo Espejo, Stgo

ANTECEDENTES

- Alternativas de Soldadura de riel en terreno
  - Arco Manual (SMAW)
    - Proceso Lento (> 5 horas).
    - Escasez de electrodos de formulación aprobada.
  - Aluminotérmica (TW)
    - Equipamiento Especial.
    - Moldes cerámicos no reutilizables de medida exactas. Las fábricas solo preparara cantidades mínimas.
    - Tiempos de preparación > 5 semanas
    - Especialización de operadores.

ANTECEDENTES

- En 1985 Prosol S.A. y Lincoln Electric idean un proceso alternativo llamado VertiRiel.
  - Proceso Rápido (10 a 15 minutos)
  - Proceso Económico
    - Equipos fáciles de obtener
    - Electrodos disponibles en el mercado
  - Moldes de Cobre que se Fabrica en Prosol (aprox. 1 semana).
  - Proceso Automático (Programable independiente de los Operadores).

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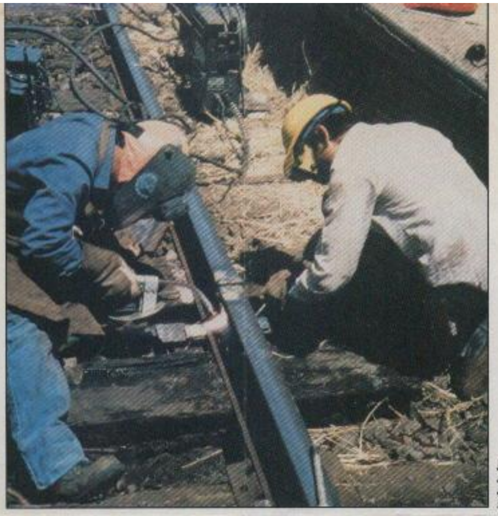

Fig. 1 — The bottom flange of the rail is joined with a conventional self-shielded flux cored electrode

Economical Welding Process Upgrades Chile's Railways

BY C. VASQUEZ R. AND S. R. EVANS

The Republic of Chile is a long, narrow country sporting a 2650-mile Pacific coastline and a width from 60 to 250 miles. It relies on its railroad system to transport both people and goods from one end of the nation to the other. As of 1984, Chilean railway traffic totaled 1.4-billion passenger-kilometers and 2.3-billion net ton-kilometers. In addition to the transportation needs of the country's people, many of Chile's most valuable natural resources must be transported hundreds of miles to reach processing facilities, domestic markets, or the ports from which they will be dispatched to foreign markets. The government has made it a priority to revamp the nation's railroad tracks as part of an upgrade of the rail system, extending the use of electric trains to lines formerly capable of carrying only diesel locomotives.

While Chile's railroad tracks themselves remain in basically good condition, the changeover to electric power allows the opportunity to improve the track by eliminating joints to give a smoother ride, as well as to provide a continuous electrical ground. Traditionally, the thermit welding process has been used to weld the joints between rail sections. However, the thermit process is time consuming and requires an expensive kit for every rail joint to be welded. In Chile, the cost of welding a single thermit joint comes to more than $60. Prosol Ltd., one of the Chilean distributors of Lincoln Electric's welding equipment and supplies, expressed a desire to approach this application in a new way.

With Lincoln Electric's assistance, procedures were developed to weld rail joints with the electrogas process using a self-shielded flux cored electrode. The vertical web and top flange were welded with a new consumable guide tube setup called Verti-Shield, using the NR-431 (AWS EG72T-1) electrode. The base, or toe area, was welded with NR-311 (AWS E70T-7), a conventional self-shielded electrode — Fig. 1. Verti-Shield is a mechanized vertical-up welding setup featuring a self-shielded flux cored electrode with a consumable guide tube — Fig. 2. The guide tube is installed on a LN-9 wire feeder. The guide tube does not have any external coating, but uses insulating rings spaced along its length to prevent it from shorting to the work on long welds. Each insulating ring is burned away as the weld progresses up the joint. Butt joints are normally welded with water-cooled copper dams, and T joints may use either steel or copper dams. The process is designed for easy setup and automatic operation, and operators need only minimal training to use it.

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The welding procedures follow a step-by-step sequence.

- The rail is unbolted, then cut with a plasma arc welding machine to provide a clean weld zone — Fig. 3.
- The gun-and-cable assembly is mounted on the rail, and positioned directly over the weld joint.
- A ¼-in. back-up plate is placed beneath the root opening.
- The consumable guide tube is positioned into the center of the weld, using ceramic spacers to prevent an electrical short to the rail.
- Copper dams are put into place.
- The weld is started on a ¼-in. plate with a copper plate underneath. The start procedure is 100-ipm wire feed speed at 35 V for 3 s. The programmable control for the wire feeder then automatically switches to the weld procedure of 230 ipm at 36 V. After 3 s, one teaspoon of 880M flux is feathered in very slowly.
- The weld continues until the arc is at the radius under the top rail. At this point, another teaspoon of flux is feathered in. When the weld pool is high enough to be oscillated across the top rail, the oscillator is turned on.
- As the oscillator moves back and forth across the joint, two more teaspoons of flux are feathered into the molten pool. Welding continues until weld is 1 in. above top surface of the rail.
- At this point, the stop button on the control panel is pushed and the controller enters the crater mode (100 ipm at 35 V) for 20 s, as the oscillator continues to oscillate. When the crater mode is finished, the oscillator is stopped.
- The weld is air carbon arc gouged in the toe (or bottom flange) area to insure 100% tie-in with rail and weld metal.
- For welding the toe or bottom flange of the rail, a 3/32-in.-diameter, NR-311 electrode was used at a procedure setting of 150 ipm, 325 A, 25 V, DC negative polarity, with a 1½-in. electrode extension. Three passes are required to complete welding of the toe area.

With this combination of processes, it was found that the butt joint could be fabricated in about 20% of the time required for a comparable thermit welded joint. That degree of success was enough to prompt additional trials.

To date, forty joints have been completed using this combination of processes. The welded tracks are currently undergoing life tests in or near the central railroad yard in Santiago. The quality of the welds appears to be excellent, and the life tests will further attest to that quality under actual loading and fatigue cycling conditions, as needed for any critical application.

So far, the total cost of welding track with this process, including consumables, comes to only 15% of the cost of a thermit welded joint. With the aid of this new technology, Chile looks forward to building a modern, streamlined electric railroad system in record time. ●

JANUARY 1989

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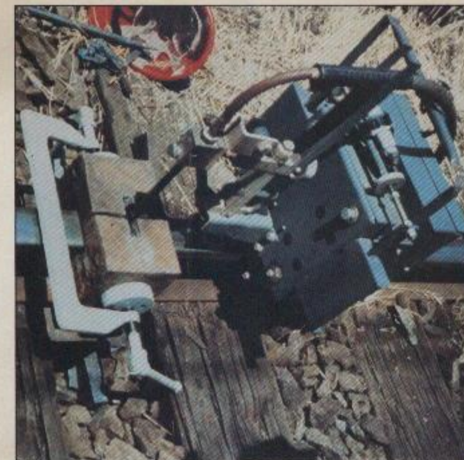

Fig. 2 — Using a consumable guide and a self-shielded flux cored electrode, a mechanized vertical-up welding system joins the web and top flange of the rail

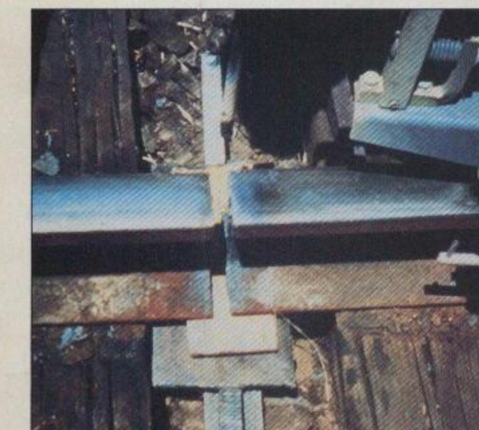

Fig. 3 — To prepare a clean weld area, the rail joint is cut with the plasma arc process

DESCRIPCION DEL PROCESO

- Se basa en el Proceso Verti Shield (Electroslag) de Lincoln Electric, utilizado para soldar Planchas Gruesas en forma vertical en la Industria Naviera.
- El proceso VertiRiel se rige por las normas, limitaciones, ventajas y calificaciones, del proceso Electroslag (EW).
- En 1985 se realizan una serie de pruebas con consumibles y equipos, aplicados para soldadura de rieles.

EQUIPOS Y MATERIALES

- Equipos:
  - Una o más fuentes de Poder (500 a 1000 A)
  - Uno o más alimentadores de electrodo Continuo.
  - Oscilador de Amplitud regulable.

- Materiales:
  - Electrodo Tubular.
  - Guía Consumible.
  - Molde de cobre reutilizable.

PROCEDIMIENTO

- *Preparación:*
  - Se procede con la limpieza, alineamiento, nivelación y ajuste de separación de rieles (20mm).
  - Se instala el oscilador, moldes de cobre, portaguía
- *Calibración:* Se regulan las fuentes de poder, velocidad de alimentación, parámetros de oscilación.
- *Soldadura:* Se verifica la bitácora de parámetros y se inicia la soldadura con el botón de partida. La soldadura se termina cuando se ha superado la cabeza del riel.
- *Terminación:* se cortan los excesos de soldadura y se procede al pulido de terminación.

Principales Aplicaciones

- 1985 A 1987 EFE
  - Soldadura de riel a manera de prueba en dos sectores de la línea central:
    - 16 uniones en Estación Central, Andén No 4.
    - 12 Soldaduras en línea de trenes de carga de cobre, sector Cerrillos, Santiago
- 1988 Cementos Polpaico
  - Soldadura de línea aérea de puente grúa.
- 1994 Minera Candelaría IV Región
  - Soldadura de anillo de riel para equipo espesador (Riel CR 171 lb).
- 1995 Puerto de San Antonio.
  - Soldadura de rieles para puentes grúas de gran tonelaje en ampliación sitio N°3.
- 1997 y 2000 Minera Escondida.
  - Soldadura de línea aérea de rieles para puentes grúas automáticos.
- 1998 y 1999 EFE
  - Recuperación de cruzamientos fabricados en tipo bloque de manganeso y del tipo rieles donde, además de la soldadura de los rieles, se practicó recuperación de las pistas de rodado, en el proyecto de mejoramiento de la vía Alameda-San Francisco Mostazal.

Principales Aplicaciones

- 2000 Codelco Divición El Teniente
  - Soldadura de rieles en Planta Filtro Caletones.
- 2002 EFE San Francisco de Mostazal - Chimbarongo
  - Recuperación de cruzamientos y pistas de rodados en la vía central.
- 2001-2003 EFE Sector Chillan - Temuco
  - Recuperación de cruzamientos Monoblock tipo K 1/13 que incluye la soldadura de sectores quebrados o reemplazo de secciones de los cruzamientos dañados, por rieles al carbono soldados al cruzamiento de manganeso.
- 2004 – 2007 EFE Santiago- Chillan (Tecdra)
  - Recuperación de cruzamientos.
- 2006 Puerto de San Antonio - Belfi
  - Soldadura rieles para puente grúa, ampliación sitio 1.
- 2007 Masonite Cabrero VIII Región
  - Soldadura de rieles puente grúa 100% Automatizado.

Principales Aplicaciones

- 2015 Metro Santiago
  - Instalación de 10 vías de taller Neptuno
- 2016 BELFI San Antonio
  - Instalación de 260 metros vía de riel A 120, en espigón del muelle costanera del puerto de San Antonio.
- 2017 FAM Los Vilos
  - Cambio de rieles 14 soldaduras en rieles MRS-125 y 6 en riel A-75.

Aplicación en puertos

Vista general después de la aplicación

Preparada para esmerilado final

Preguntas?

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